

Claims:

1. A multi-step aqueous composition useful for polishing a tantalum barrier material and copper from a semiconductor wafer, comprising by weight percent 0.1 to 30 oxidizer, 0.01 to 3 inorganic salt or acid, 0.01 to 4 inhibitor, 0.1 to 30 abrasive, 0 to 15 complexing agent and balance water, wherein the aqueous composition has a pH between 1.5 to 6.

2. The composition of claim 1 wherein the composition comprises 0.1 to 1 weight percent inorganic salt.

3. The composition of claim 1 wherein the aqueous composition has a pH between 2 to 3.

4. The composition of claim 1 wherein the inorganic salt is selected from the group comprising: phosphate, pyrophosphate, polyphosphate, phosphonate, sulfate, pyrosulfate, polysulfate, sulfonate and their acids, salts, mixed acid salts, esters, partial esters, mixed esters, and mixtures thereof.

5. The composition of claim 1 wherein the inorganic salt is selected from the group comprising: zinc phosphate, zinc pyrophosphate, zinc polyphosphate, zinc phosphonate, ammonium phosphate, ammonium pyrophosphate, ammonium polyphosphate, ammonium phosphonate, diammonium phosphate, diammonium pyrophosphate, diammonium polyphosphate, diammonium phosphonate, guanidine phosphate, guanidine pyrophosphate, guanidine polyphosphate, guanidine phosphonate, iron phosphate, iron pyrophosphate, iron polyphosphate, iron phosphonate, cerium phosphate, cerium pyrophosphate, cerium polyphosphate, cerium phosphonate, ethylene-diamine phosphate, piperazine phosphate, piperazine pyrophosphate, piperazine phosphonate, melamine phosphate, dimelamine phosphate, melamine pyrophosphate, melamine polyphosphate, melamine phosphonate, melam phosphate, melam pyrophosphate, melam polyphosphate, melam phosphonate, melem phosphate, melem pyrophosphate, melem polyphosphate, melem phosphonate, dicyanodiamide phosphate, urea phosphate, zinc sulfate, zinc pyrosulfate, zinc polysulfate, zinc sulfonate, ammonium sulfate, ammonium pyrosulfate, ammonium polysulfate, ammonium sulfonate, diammonium sulfate, diammonium pyrosulfate, diammonium polysulfate, diammonium sulfonate, guanidine sulfate, guanidine pyrosulfate, guanidine

polysulfate, guanidine sulfonate, iron sulfate, iron pyrosulfate, iron polysulfate, iron sulfonate, cerium sulfate, cerium pyrosulfate, cerium polysulfate, cerium sulfonate, ethylene-diamine sulfate, piperazine sulfate, piperazine pyrosulfate, piperazine sulfonate, melamine sulfate, dimelamine sulfate, melamine pyrosulfate, melamine polysulfate, melamine sulfonate, melam sulfate, melam pyrosulfate, melam polysulfate, melam sulfonate, melem sulfate, melem pyrosulfate, melem polysulfate, melem sulfonate, dicyanodiamide sulfate, urea sulfate, and their acids, salts, mixed acid salts, esters, partial esters, mixed esters, and mixtures thereof.

6. The composition of claim 1 wherein the oxidizer is selected from the group comprising: hydrogen peroxide, monopersulfates, iodates, magnesium perphthalate, peracetic acid, persulfates, bromates, periodates, nitrates, iron salts, cerium salts, Mn (III), Mn (IV) and Mn (VI) salts, silver salts, copper salts, chromium salts, cobalt salts, halogen hypochlorites and a mixture thereof.

7. A multi-step aqueous composition useful for polishing a tantalum barrier material and copper from a semiconductor wafer, comprising by weight percent 0.1 to 30 hydrogen peroxide, 0.01 to 3 inorganic salt or acid, 0.01 to 4 inhibitor, 0.1 to 30 abrasive, 0 to 15 complexing agent and balance water, the aqueous composition having a pH between 1.5 to 6, wherein the inorganic salt is selected from the group comprising: zinc phosphate, zinc pyrophosphate, zinc polyphosphate, zinc phosphonate, ammonium phosphate, ammonium pyrophosphate, ammonium polyphosphate, ammonium phosphonate, diammonium phosphate, diammonium pyrophosphate, diammonium polyphosphate, diammonium phosphonate, guanidine phosphate, guanidine pyrophosphate, guanidine polyphosphate, guanidine phosphonate, iron phosphate, iron pyrophosphate, iron polyphosphate, iron phosphonate, cerium phosphate, cerium pyrophosphate, cerium polyphosphate, cerium phosphonate, ethylene-diamine phosphate, piperazine phosphate, piperazine pyrophosphate, piperazine phosphonate, melamine phosphate, dimelamine phosphate, melamine pyrophosphate, melamine polyphosphate, melamine phosphonate, melam phosphate, melam pyrophosphate, melam polyphosphate, melam phosphonate, melem phosphate, melem pyrophosphate, melem polyphosphate, melem phosphonate, dicyanodiamide phosphate, urea phosphate, zinc sulfate, zinc pyrosulfate, zinc polysulfate, zinc sulfonate, ammonium

sulfate, ammonium pyrosulfate, ammonium polysulfate, ammonium sulfonate, diammonium sulfate, diammonium pyrosulfate, diammonium polysulfate, diammonium sulfonate, guanidine sulfate, guanidine pyrosulfate, guanidine polysulfate, guanidine sulfonate, iron sulfate, iron pyrosulfate, iron polysulfate, iron sulfonate, cerium sulfate, cerium pyrosulfate, cerium polysulfate, cerium sulfonate, ethylene-diamine sulfate, piperazine sulfate, piperazine pyrosulfate, piperazine sulfonate, melamine sulfate, dimelamine sulfate, melamine pyrosulfate, melamine polysulfate, melamine sulfonate, melam sulfate, melam pyrosulfate, melam polysulfate, melam sulfonate, melem sulfate, melem pyrosulfate, melem polysulfate, melem sulfonate, dicyanodiamide sulfate, urea sulfate, and their acids, salts, mixed acid salts, esters, partial esters, mixed esters, and mixtures thereof.

8. A method for polishing a tantalum barrier material and copper from a semiconductor wafer comprising:

contacting the wafer with a polishing composition, the wafer containing the tantalum barrier material and copper, the polishing composition comprising by weight percent 0.1 to 30 oxidizer, 0.01 to 3 inorganic salt or acid, 0.01 to 4 inhibitor, 0.1 to 30 abrasive, 0 to 15 complexing agent and balance water, wherein the aqueous composition has a pH between 1.5 to 6; and

polishing the wafer with a polishing pad.

9. The method of claim 8 wherein the inorganic salt is selected from the group comprising: zinc phosphate, zinc pyrophosphate, zinc polyphosphate, zinc phosphonate, ammonium phosphate, ammonium pyrophosphate, ammonium polyphosphate, ammonium phosphonate, diammonium phosphate, diammonium pyrophosphate, diammonium polyphosphate, diammonium phosphonate, guanidine phosphate, guanidine pyrophosphate, guanidine polyphosphate, guanidine phosphonate, iron phosphate, iron pyrophosphate, iron polyphosphate, iron phosphonate, cerium phosphate, cerium pyrophosphate, cerium polyphosphate, cerium phosphonate, ethylene-diamine phosphate, piperazine phosphate, piperazine pyrophosphate, piperazine phosphonate, melamine phosphate, dimelamine phosphate, melamine pyrophosphate, melamine polyphosphate, melamine phosphonate, melam phosphate, melam pyrophosphate, melam polyphosphate, melam phosphonate,

melem phosphate, melem pyrophosphate, melem polyphosphate, melem phosphonate, dicyanodiamide phosphate, urea phosphate, zinc sulfate, zinc pyrosulfate, zinc polysulfate, zinc sulfonate, ammonium sulfate, ammonium pyrosulfate, ammonium polysulfate, ammonium sulfonate, diammonium sulfate, diammonium pyrosulfate, diammonium polysulfate, diammonium sulfonate, guanidine sulfate, guanidine pyrosulfate, guanidine polysulfate, guanidine sulfonate, iron sulfate, iron pyrosulfate, iron polysulfate, iron sulfonate, cerium sulfate, cerium pyrosulfate, cerium polysulfate, cerium sulfonate, ethylene-diamine sulfate, piperazine sulfate, piperazine pyrosulfate, piperazine sulfonate, melamine sulfate, dimelamine sulfate, melamine pyrosulfate, melamine polysulfate, melamine sulfonate, melam sulfate, melam pyrosulfate, melam polysulfate, melam sulfonate, melem sulfate, melem pyrosulfate, melem polysulfate, melem sulfonate, dicyanodiamide sulfate, urea sulfate, and their acids, salts, mixed acid salts, esters, partial esters, mixed esters, and mixtures thereof.

10. The method of claim 8 wherein the oxidizer is selected from the group comprising: hydrogen peroxide, monopersulfates, iodates, magnesium perphthalate, peracetic acid, persulfates, bromates, periodates, nitrates, iron salts, cerium salts, Mn (III), Mn (IV) and Mn (VI) salts, silver salts, copper salts, chromium salts, cobalt salts, halogen hypochlorites and a mixture thereof.